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AN EVALUATION OF DIFFERENTIAL ATTRACTIVENESS OF SUNFLOWER GENOTYPES TO HONEY BEES

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MATERIALS AND METHODS

A number of sunflower genotypes were seeded in randomized, complete blocks at Northrup King Research Centers near Eden Prairie, Minnesota and Woodland, California in 1978 and 1979. Entries were replicated two or four times and plots were two rows, six meters long, 76 cm apart. Several colonies of honey bees (Italian race) were placed near each trial location to ensure a sufficient population of pollinators.

Honey bees visiting each genotype were counted ten times during the bloom period. The number of honey bees observed in one instant on ten heads of each plot was recorded during each observation. Observations were generally made twice a day, once in the morning and once in the afternoon. Mean visitations were calculated on the basis of 100 total heads per genotype.

The corolla tube length of each genotype was determined at the Minnesota location in 1979. The distance from the distal portion of the flower nectary to the most basal portion of the corolla tube opening was measured on two florets from six heads per replication at full bloom.

Stigmatic pigmentation was also noted at the Minnesota location in 1979. Stigmatic pigmentation was rated on a "one to four" scale with one being lightest in color and four being darkest.

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RESULTS AND DISCUSSION

Significant differences in honey bee visitation were found among the sunflower genotypes evaluated (Table 1). The magnitude of the pollinator population differed by location yet the relative ranking of the genotypes was reasonably consistent. This indicates that bee attractiveness of genotypes is stable over environments and the method of evaluation is valid.

Pollen was not a significant attractant (Table 1). Male sterile (SW prefix) and corresponding male fertile (W prefix) forms of inbred lines did not differ in bee attractiveness at either location. RW lines

Table 1

Mean number of honey bees visiting various genotypes per observation at two locations.

Genotype	honey bees per observation	
	Woodland, Ca. 1979	Eden Prairie, Mn. 1979
SW506 x RW635	10.8	1.4
SW501 x R5E	10.2	2.4
SW501	10.1	7.9
W501	9.6	5.7
SW501 x RW637	8.8	2.6
SW514 x RW637	8.2	0.8
R5E	8.1	2.8
SW506	7.3	1.3
SW517 x RW637	7.2	0.6
W506	7.0	0.9
RW635	6.6	3.5
W514	5.0	0.8
SW517 x RW636	4.7	0.4
RW636	3.7	2.1
SW514	3.7	0.3
RW637	3.4	0.7
W517	2.5	0.3
SW517	1.9	0.1
LSD (0.05)	1.8	0.9

are restorers and all other genotypes are hybrids based on cytoplasmic male sterility.

Honey bee visitation was highly associated with corolla tube length (Table 2). The negative correlation between honey bee visitation and corolla tube length supports Cirnu's et al (1974) statement that sunflower pollination is influenced by nectar accessibility. The correlation suggests that nectar may be more difficult to collect from genotypes with long corolla tubes.

Genotypes with dark stigmatic pigmentation were associated with intermediate and low bee visitation. Since the genotypes with dark

Table 2

Honey bee visitation, corolla tube length and stigmatic pigmentation at Eden Prairie, Mn. 1979.

Entry	mean bees/ observation	corolla tube length (mm)	stigma color[1]
W501	5.7	4.08	1.0
SW501 x RW637	2.6	4.70	1.0
SW501 x R5E	2.4	4.98	1.0
SW506 x RW635	1.4	5.08	1.0
Peredovik	1.2	4.90	1.5
W506	0.9	4.78	2.0
W514	0.8	4.63	3.0
SW514 x RW637	0.8	4.78	3.0
SW517 x RW637	0.6	5.03	4.0
SW517 x RW636	0.4	5.13	4.0
W517	0.3	5.15	4.0
LSD (0.05)	0.7	0.28	0.2
r bees and corolla length		—0.810**	
r bees and stigma color			—0.680*

1 - pigmentation rated 1-4, 4 being darkest

*, ** correlations significant at the 0.05 and 0.01 levels of probability, respectively.

stigmata also had long corolla tubes, it is impossible at this point to evaluate the effect of stigmatic pigmentation. The appearance of flowering heads with dark stigmata however, is very similar to the color of "normal" heads after flowering is complete. Dark stigmatic types may falsely signal bees that flowering has finished and nectar is no longer available. Further experiments are being conducted to determine if stigmatic pigmentation affects bee attractiveness.

High honey bee attractiveness in commercial cultivars, although desirable in self-incompatible and low self-pollinating types, is probably most important in the production of hybrid planting seed. Hybrid seed is produced on male sterile inbreds and success or failure is dependent upon pollination by honey bees. Male sterile and pollinator lines with high honey bee attractiveness would minimize the affect of competing species for the available resource of pollinators. Corolla tube length is highly associated with honey bee attractiveness and may provide the breeder with a direct criterion for selecting bee attractive genotypes.

ABSTRACT

Investigations into the causes of sporadic seed yields of an important cultivar led to the evaluation of a number of genotypes to determine their attractiveness to honey bees, *Apis mellifera.* Honey bee visitations were recorded on flowering heads of each genotype ten different times over a ten day period. Large differences in the number of visitations were observed among entries and it is believed that these differences are good measures of relative honey bee atractiveness. Results were consistent in tests planted at Eden Prairie, Minnesota and Woodland, California in 1978 and 1979.

In an attempt to develop a screening method capable of predicting highly attractive genotypes, visitation data were correlated with various morphological characters. Significant negative correlations were found between bee visitation and corolla tube length and stigmatic pigmentation. These data indicate that morphological traits may be used in a comprehensive screening program to predict the relative honey bee attractiveness of sunflower genotypes.

The yield of an important sunflower cultivar was inconsistent in North Dakota and Minnesota in 1977. Field observations prior to harvest revealed reduced seedset on a high percentage of individual plants. The pattern of seedset was random and the reduction could not be explained by environmental conditions known to affect pollen

viability or stigmatic receptiveness. Breeding and evaluation data accumulated over several years at numerous locations tended to eliminate self-incompatibility as a factor. The conditions appeared to be the result of incomplete pollination due to reduced honey bee activity.

It is well known that honey bees are preferentially attracted to some flowering plant species over others. Genotypic differences within species have also been reported. Kauffeld et al (1967) and Loper et al (1974) identified differential honey bee attractiveness among specific clones of alfalfa *(Medicago sativa* L.) and Cirnu et al (1974) detected preferences among sunflower cultivars.

Most differences in bee attractiveness are due to differences in floral characteristics. Burmistrov (1965) demonstrated nectar quantity was an important factor and Cirnu et al (1974) indicated that accessibility was also important. Waller's (1972) study using sugar solutions of various concentrations demonstrated that nectar quality can also be involved.

These experiments were conducted to determine if differential honey bee attractiveness existed among selected sunflower genotypes, if the differences could be easily measured, and if morphological characteristics were associated with honey bee attractiveness.

REFERENCES

BURMISTROV, A. N., 1965. The melliferous value of some sunflower varieties. 20th Intl. Apic. Cong. Proc., Bucharest: 320-323.

CIRNU, I., V. DUMITRACHE, and E. HOCIOTA, 1974. La pollinisation du tournesol (*Helianthus annuus* L.) a Paide des abeilles - un facteur important pour Paugmentation de la production. Proc. 6th International Sunflower Conference, July 22-24, 1974, Bucharest: 695-700.

KAUFFELD, N. M., E. L. SORENSEN and R. H. PAINTER. 1967. Preferences of two races of honey bees for selected alfalfa clones under competitive and non-competitive foraging. Jour. Econ. Ent. 60:1135-1139.

LOPER, G. M., WALLER, G. D. and BERDEL, R. L., 1974. Olfactory screening of alfalfa clones for uniform honey bee selection. Crop Sci. 14: 120-122.

WALLER, G. D., 1972. Evaluating response of honey bees to sugar solutions using an artificial flower feeder. Ann. Ent. Soc. Am. 65:857-862.